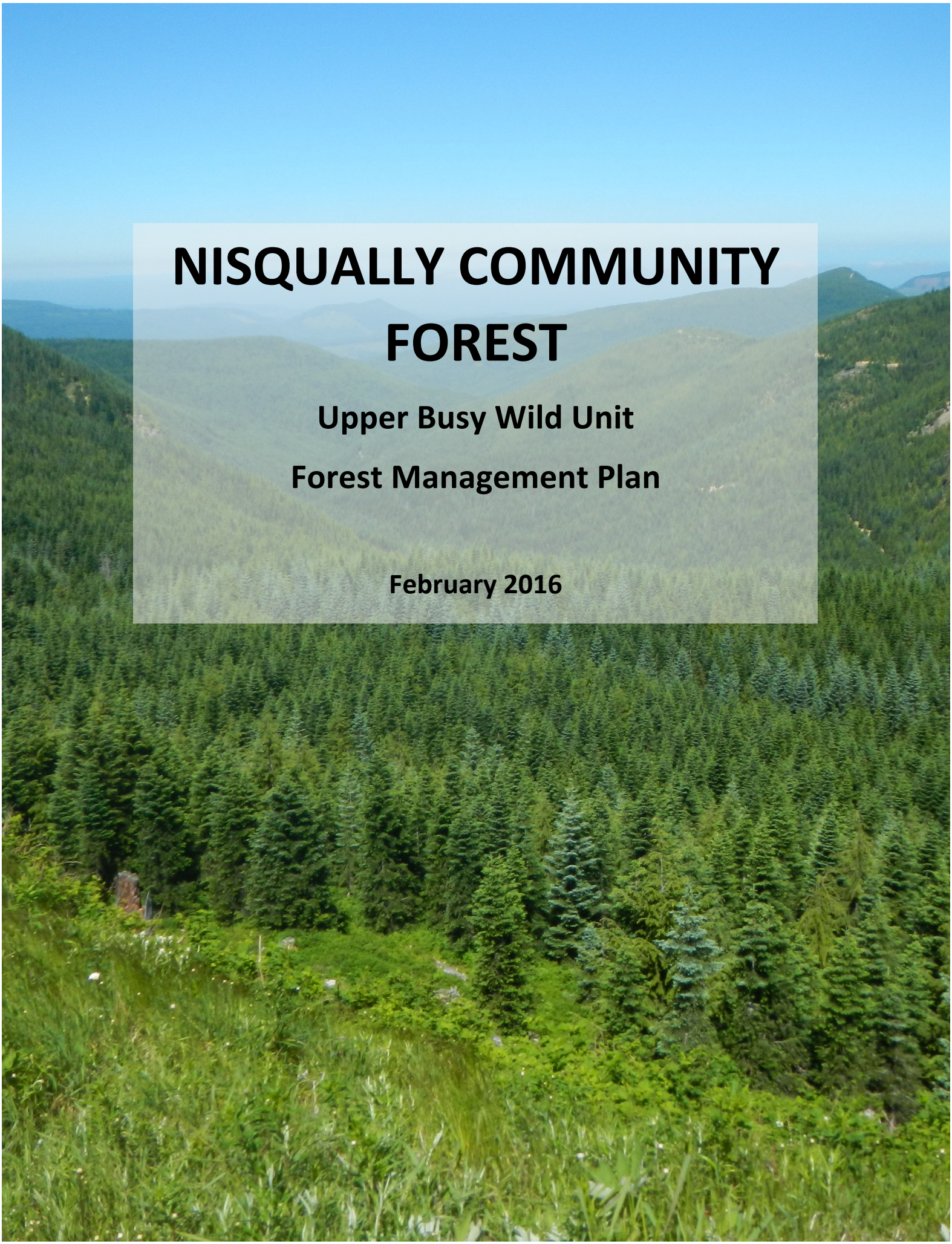


NISQUALLY COMMUNITY FOREST

Upper Busy Wild Unit

Forest Management Plan

February 2016

CONTENTS

INTRODUCTION

Overview

The Nisqually Community Forest is an effort to bring the commercial forest lands of the Nisqually watershed to locally based ownership. This will allow for greater control in how the forest are managed so that conservation is valued over revenue. This does not mean that the forest will become a preserve, these forests will be operated as working forests providing timber and non-timber forest products along with local jobs and recreational opportunities for the community. This ethos is captured in the mission of the Nisqually Community Forest:

> "The Nisqually Community Forest acquires and manages working forests in the Nisqually watershed to provide sustainable economic, environmental, and social benefits to local communities."

The forests of the upper Nisqually have passed through many different private owners from the original railroad grant through the Timber Investment Management Organization that owns it today. This effort seeks to bring these lands under local community management so that we can put efforts like salmon recovery first and foremost in the forest management planning effort.

The Upper Busy Wild unit is located 1 mile north of Ashford in the western foothills of Mount Rainier in the south easternmost portion of the Mashel Sub-basin of the Nisqually Watershed. It is covered by relatively dense forest of 30-55 year old fir species (Silver, Noble, Grand) mixed with western hemlock and Douglas fir. The Unit ranges in elevation from 2,880 feet to 4,690 feet.

The purpose of this plan is twofold. Firstly it will lay out the forest management plans for the Upper Busy Wild unit of the Nisqually Community Forest, this unit represents the first purchase of land for the Community Forest, and the plans laid out here will help set the direction of the entire community forest. To that end, it will secondly, serve as a template for all future plans of the Nisqually Community Forest as it continues to add properties as it works towards the goal of owning all or most of the commercial forest land in the Nisqually Watershed.

15 years ago, the State of Washington executed a comprehensive modification of its Forest Practices Act. This followed the listing of several salmonoid species under the Endangered Species Act. At issue is the practice of even-aged silvicultural treatments (e.g. clear cutting), held as an industry standard for decades, and the impacts of intensive forest management practices near sensitive aquatic and wildlife habitat sites. Regulatory changes have primarily involved an increase in forest buffer widths, which preclude silvicultural activity in critical areas such as riparian management zones, wetland buffers and habitats for rare, threatened and endangered species.

The region's long history of large-scale, even-aged clearcuts has created significant fragmentation of wildlife habitat, an epidemic of young, low quality Douglas fir, and an oversimplification of the broad range of ecosystem services that historic, naturally diverse forests once provided. The industrial argument in favor of even-aged management has focused on the economic efficiencies of intensive plantation

management. Smaller, non-industrial private forest (NIPF) landowners throughout the region follow a more diverse spectrum of silvicultural methods that include even-aged management as well as a more natural, uneven-aged and mixed species approach to forestry.

There is a growing understanding of the ecosystem service benefits of structurally intact native forests. Natural forest ecosystems are highly resilient to and recover quickly from natural disturbance regimes, have superior storm water retention capacities, optimize the sequestration and long-term storage of carbon, provide a broad spectrum of habitat niches, produce multiple forest commodities, and supply recreational and hunting opportunities to local communities.

Goals & Objectives

The objectives of the forest management for the overall Nisqually Community Forest are to lengthen overall rotations, practice more commercial thinning from below, increase stream buffers, and protect unstable slopes.

Short term (1-10 years)

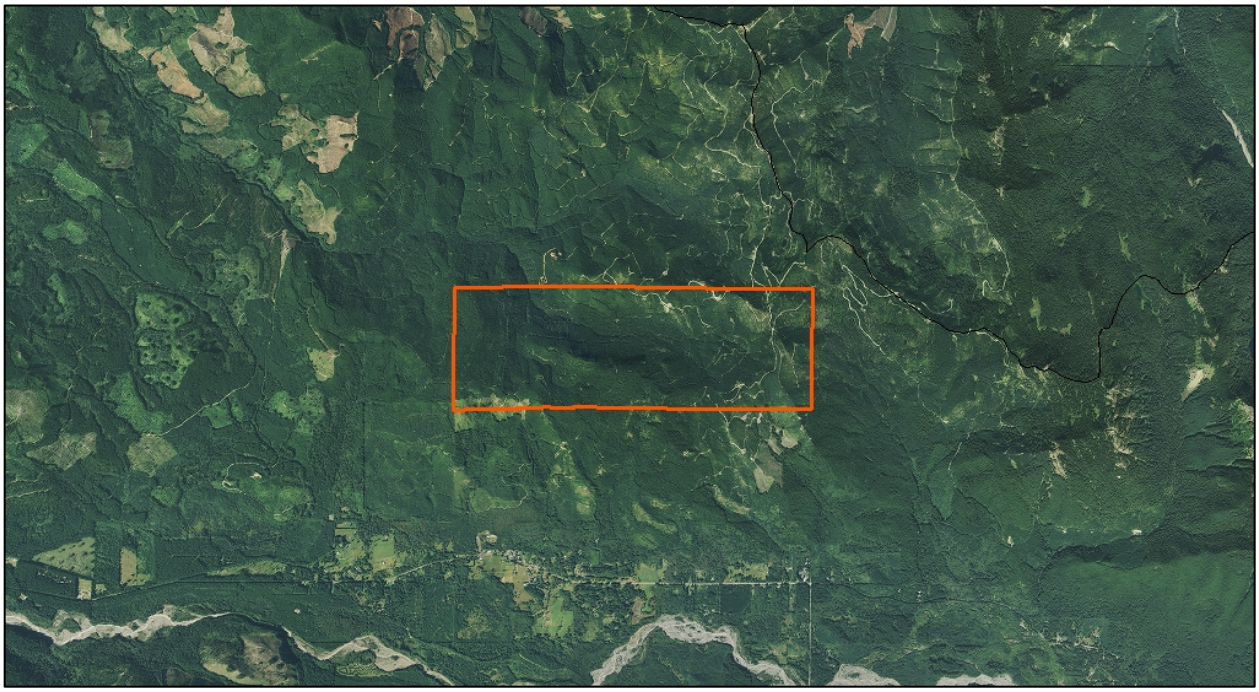
1. *Thin dense stands to enhance forest health and timber productivity*
2. *Improve wildlife habitat through snag creation, distribution of downed woody debris and forage planting*
3. *Develop and implement control and eradication measures for noxious non-native plant species*
4. *Begin a systematic monitoring program to inventory and assess forest resources and wildlife habitat*
5. *Develop an annual or semi-annual commercial thinning plan that provides sufficient income to pay for all forest management expenses and provide positive revenue to the community forest*
6. *Implement research and development programs to demonstrate structure-based forest management principles*
7. *Host educational forestry tours and events for the public.*

Long term (10+ years)

1. *Restore historic species composition and habitat complexity throughout forest*
2. *Begin restoring areas of forest to late seral conditions*
3. *Produce periodic income through commercial thinning*
4. *Use forest resources as a model for structure-based forest management*
5. *Recruit or retain legacy trees, old and large trees, snags and downed woody debris in order to sustain populations of native plants, fungi, and animals, both within individual forest stand and across the entire forest*

6. *Monitor forest ecosystem dynamics, record and analyze trends and periodically update forest management plan to reflect new strategies for managing the forest*

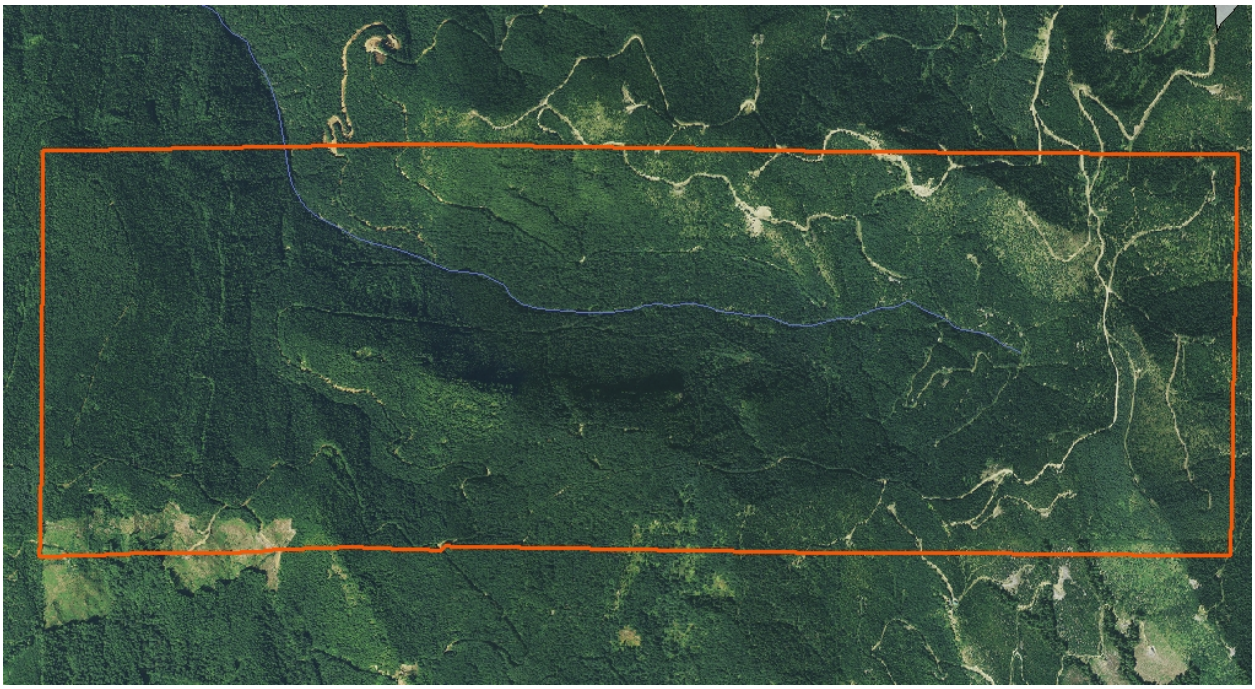
Region



Upper Busy Wild Unit located just north of Ashford.

The target area of the Nisqually Community Forest is located in the western foothills of Mount Rainier, primarily located in the Mashel and Ohop sub-basins of the Nisqually watershed.

The Upper Busy Wild Unit consists of three section located in the Nisqually Watershed, in Pierce County, 1 mile north of Ashford. Township 6, Range 15, Sections 13,14, and 15. Access to the property is through the existing Hancock road network either from the Ashford area or the Eatonville area. The Mount Tahoma Trails Association has a rental agreement covering their Copper Creek Hut and associated ski trails on the property.



Upper Busy Wild Unit.

Climate

The Ashford has a warm-summer Mediterranean climate. The mean annual precipitation is about 100 inches, 85 inches of rain per year and 56 inches of snowfall. There are an average of 158 days of measurable precipitation and 139 sunny days per year. The July high is around 75 degrees. The January low is 25.

Surrounding Land Uses

Mount Rainier dominates the area and the National Park is a huge tourism and recreation draw. Over 2 million people visit the Park each year. The Upper Nisqually Watershed has a long history of commercial forest management and the Upper Busy Wild Unit is surrounded by commercial forest or former commercial forest land. The property is bounded on the north by Hancock Forest Management lands, the east by the Gifford Pinchot National Forest, the south by Nisqually Land Trust lands that were purchased from Hancock for Endangered Species protection, and to the west by the Washington Department of Natural Resources Elbe Hills State Forest

Past Management History

The majority of the Upper Busy Wild sub-basin was harvested in the 1970's and 1980's. Most of the area is heavily roaded and is 2nd growth forest. Past management practices include harvest right down to the watercourse and massive scale clearcutting.

Salmon Recovery Impacts

This project's goal is to permanently protect habitat for threatened Nisqually steelhead trout and Chinook salmon and to protect the recovery trajectory of upper Busy Wild Creek through acquisition of

sensitive properties under immediate threat of clearcut logging. Acquisition of this forestland will ensure that the watershed continues to recover from past forestry practices. It will protect a portion of the watershed critical for sediment-supply processes from intensive logging that could result in devastating erosion, and it will protect forestland along upper Busy Wild Creek and its tributaries from additional logging while providing future opportunities for active forestland restoration, including road abandonment and riparian enhancement.

Busy Wild Creek is the largest sub-basin of the Mashel River Washington Administrative Unit (WAU). The Mashel River is the largest tributary to the Nisqually River, and Busy Wild Creek is the Nisqually River Watershed's uppermost spawning and rearing location for Chinook, coho, and pink salmon and steelhead trout. (Figure 1).

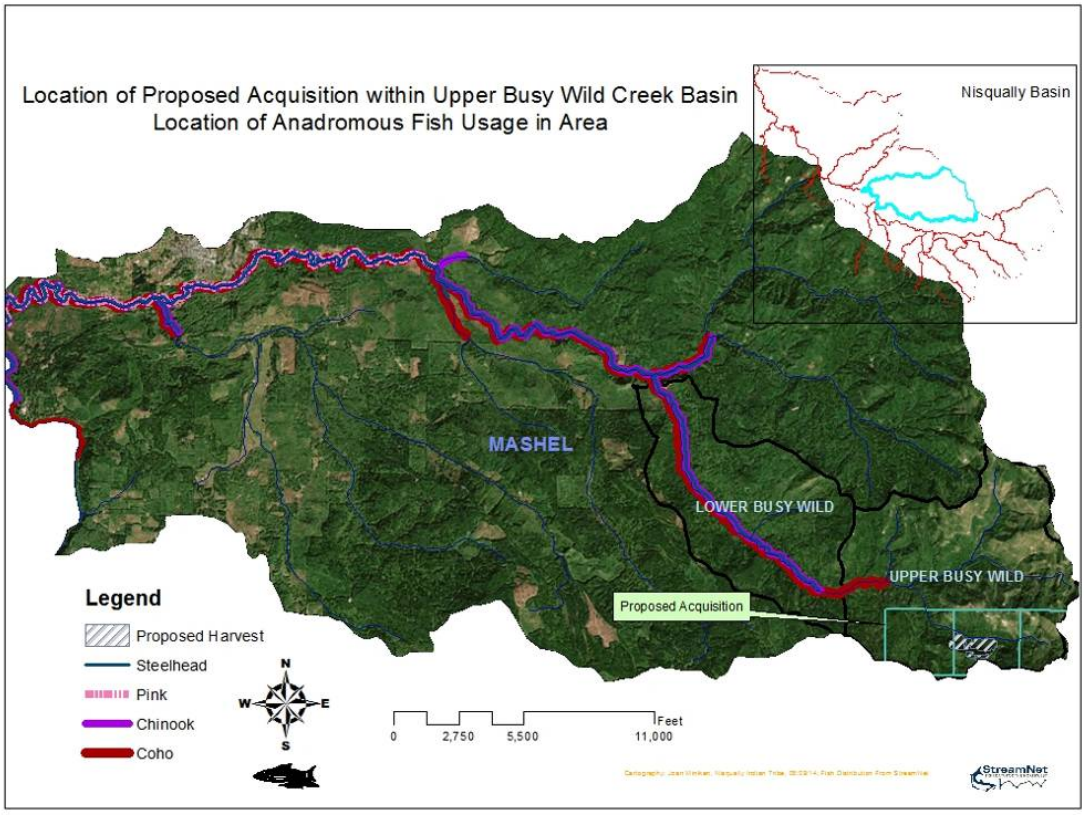


Figure 1: Mashel River, Upper and Lower Busy Wild Creek, and proposed acquisition

The upper Mashel River WAU remains in intensive commercial forestry while still in a state of recovery from massive clearcut logging operations in the early and mid-1900s. It has been damaged by extensive sediment loads filling pools and spawning gravel, reduced water retention, elevated stream temperatures, and poor large-woody-debris recruitment. Recently, with increased domestic and export demand for timber, the Busy Wild sub-basin has been undergoing another round of intensive logging, threatening the recovery of critical watershed processes.

Adverse conditions for salmon related to timber management in the Mashel WAU are well documented. The Mashel Watershed Analysis (Bohle et al., 1996) assessed unstable slopes and geomorphology in the Mashel.

Specialists reviewed aerial photos from 1942 to 1993, field verified the results, and determined that timber-related activities in the upper Busy Wild can trigger debris avalanches on steep-sloped forests. The soils in this area are Eocene and Oligocene andesite, volcaniclastic, and sedimentary rocks that are very weathered and fractured at the surface. Smaller, relatively frequent debris avalanche events were initiated from steep road-fill slopes that failed at stream crossings. Assessors noted that the volume of sediment generated relative to large natural events is small but large enough to impact anadromous fish, particularly with increased rates of timber harvest. Debris avalanches scour, widen, and simplify the channel shape, fill pools, and increase aggradation, reducing the quality of spawning, rearing, and holding habitats. Road-building and stream-crossing techniques have improved hydraulic conveyance, but this is an area with high precipitation, steep slopes, and weak soils, making it prone to failing when tree-root strength is removed and culverts and fill slopes fail.

The benefits of this protection project and subsequent restoration will be seen in the adjacent Busy Wild stream channel and in the 14.5 miles of Mashel River downstream. This includes benefits to the lowest several miles of the Mashel River, a section that is used for spawning-ground survey index counts because it is the most heavily used tributary spawning area for Chinook salmon and steelhead trout.

The fish resources listed below describe the steelhead trout and coho salmon presence at the site and the Chinook and pink salmon presence in the reach immediately below (and thus heavily influenced by) the site.

Species	Life History Present (egg, juvenile, adult)	Current Population Trend (decline, stable, rising)	ESA Coverage (Y/N)	Life History Target (egg, juvenile, adult)
Winter Steelhead Trout	Spawning, egg incubation, fry colonization, rearing, prespawning migrant, prespawning holding	Decline	Yes	Egg, juvenile, adult
Chinook salmon	Spawning, egg incubation, fry colonization, rearing, prespawning migrant, prespawning holding	Decline	Yes	Egg, juvenile, adult
Coho salmon	Spawning, egg incubation, fry colonization, rearing, prespawning migrant, prespawning holding	Unknown	N	Egg, juvenile, adult
Pink salmon	Spawning, egg incubation, prespawning migrant, prespawning holding	Rising	N	Egg

The Nisqually Chinook Recovery Plan ranks protection and restoration of the Mashel River drainage just behind the Nisqually estuary and mainstem as the top priority for recovery. Additionally, the draft Nisqually Winter Steelhead Recovery Plan ranks protection and restoration of the Mashel River in general and the Busy Wild Creek sub-basin in particular as the top drainage for restoration and the second highest for protection, just behind the Nisqually River mainstem. The key habitat attributes in

need of protection and restoration are directly related to forestry in the upper Mashel/Busy Wild. The impaired habitat conditions in need of passive and active restoration are: sediment load, summer stream temperature, key habitat quantity (pools), large woody debris, scour caused by peak stream flows (channel instability), and low summer baseflows. The Washington Department of Ecology's Puget Sound Watershed Characterization gives the Busy Wild project site its highest ranking for protection and restoration of sediment-supply processes.

Forest management practices on this property will be crafted to minimize the risk of new sediment inputs in the system and to provide the maximum shading possible to the streams of the property. Forest management will consist primarily of multiple entry thinning and no opening greater than 6 acres will be created.

RESOURCE DESCRIPTIONS & MANAGEMENT PRACTICES

Forest Health

Naturally occurring fungi and insects are important components of forest ecosystems. Some cause disease and damage while others play a more beneficial role in the production of timber products. All are important in the functioning of a forest ecosystem.

Insects

The impact of insects on the Upper Busy Wild is awaiting a more in depth field review of the property.

Invasive species

The impact of invasive species on the Upper Busy Wild is awaiting a more in depth field review of the property.

Chemical use policy

Forest management will employ silvicultural systems, integrated pest management, and strategies for controlling pests or invasive species that minimize the need for the use of chemicals. Non-chemical control strategies, such as hand-pulling, mowing, weed whacking, etc., will be considered before chemical applications. Maintaining sufficient canopy cover to provide shade-suppression of invasive species will be the dominant management strategy.

Chemicals will only be used where less environmentally hazardous techniques have been shown through research or empirical experience to be ineffective. Chemical use may be necessary to control invasive weed species that have the potential for altering forest habitat function and in some cases where invasive or native species are aggressively encroaching on active forest roads. When chemicals are applied, the least environmentally hazardous option will be used to minimize effects on non-target organisms or ecological systems. Furthermore, where chemical use is deemed necessary, trained applicators will follow all applicable safety precautions and chemicals will be stored and disposed of in a safe and environmentally appropriate manner. Records of chemical use will be maintained, including the type of chemical, when and where it was applied, on what species it was applied and the effectiveness of the application.

Noxious weeds will be identified and treated according to the Washington State Noxious weeds law. Use of non-native vegetation in developed areas adjacent to the forest, such as landscaping around structures or gardening activities, should be discouraged, and if used, should not be included on the County noxious weed list. Hand or mechanical means of eradicating noxious weeds will be prioritized, and should chemical treatment be necessary, a low impact, short-lived herbicide may be used according to directions and with care to avoid native vegetation.

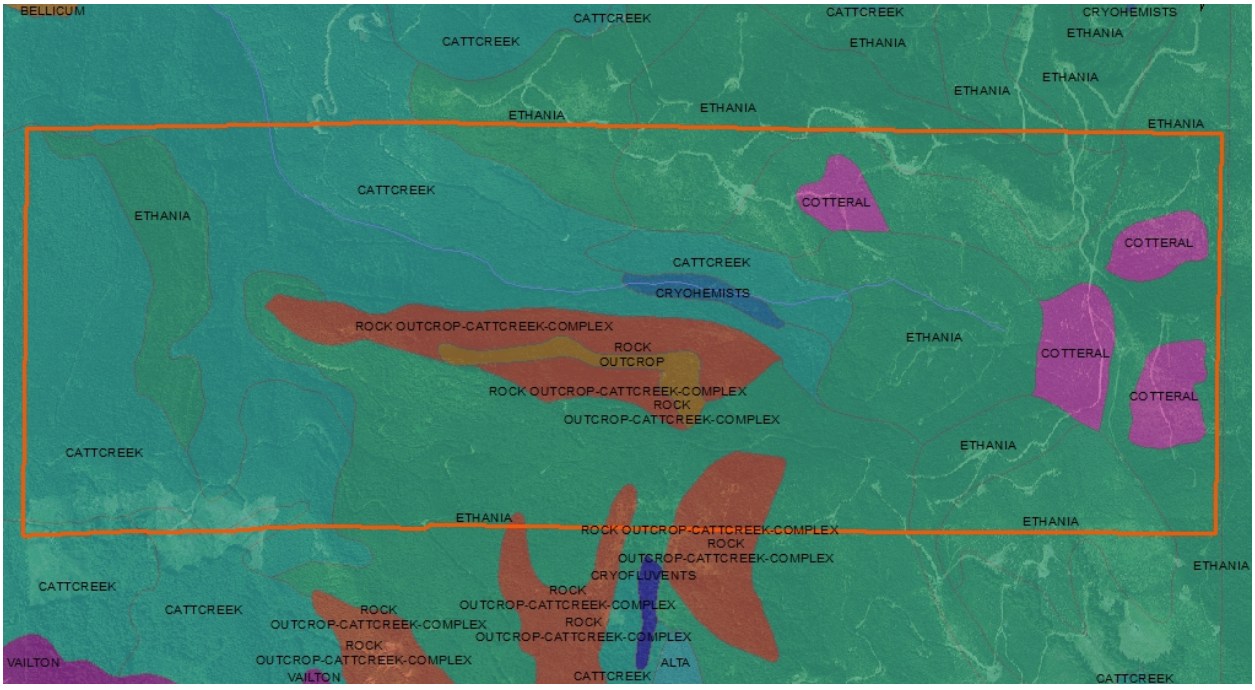
World Health Organization Type 1A and 1B and chlorinated hydrocarbon pesticides; pesticides that are persistent, toxic or whose derivatives remain biologically active and accumulate in the food chain beyond their intended use; as well as any pesticides banned by international agreement, will be prohibited. If chemicals are used, proper equipment and training are required to minimize health and environmental risks.

Records of chemical use will be maintained, including the type of chemical, when and where it was applied, on what species it was applied and the effectiveness of the application. The Club will abide by the following FSC guidelines for chemical use.

Standard	Source
Chemical pesticides, fungicides, and herbicides will be used only when and where research or empirical experience has demonstrated that less environmentally hazardous, non-chemical pest/disease management practices are ineffective.	FSC U.S. Standards 6.6.b.
When and where chemicals are applied, the most environmentally safe and efficacious chemicals are used. Chemicals are narrowly targeted, and minimize effects on non-target species.	FSC U.S. Standards 6.6.c.
Chemicals will be used only when and where they pose no threat to supplies of domestic water, aquatic habitats, or habitats of rare species.	FSC U.S. Standards 6.6.d.
When chemicals are used, the effects and impacts will be monitored and the results used for adaptive management. Records will be kept of pest occurrences, control measures, and incidences of worker exposure to chemicals.	FSC U.S. Standards 6.6.e.

Chemical use guidelines. From https://us.fsc.org/

Geology & Soils



The soils of the Upper Busy Wild Unit.

The geology of the Upper Busy Wild is dominated by the effects of Mount Rainier. Mount Rainier is a stratovolcano, a composite volcano created through successive eruptions of lava and pyroclastic flows. It is one of more than a dozen stratovolcanoes perched on older rocks of the Cascade Range. The prevailing rock type of the Cascade volcanoes is andesite, an igneous rock of intermediate composition between light- colored, silica- rich rocks (e.g., rhyolite) and dark, basaltic rocks that contain very little silica. Andesite is typically dark gray or greenish black in color and is composed of approximately equal amounts of light- colored minerals like plagioclase feldspars and dark minerals like hornblende, olivine, and pyroxenes. The landscape of the general Mount Rainier area is complex, but its origins are simple: fire and ice. The mountain first erupted about half a million years ago and as recently as in the 1840s. Two large eruptions took place, first about 2,300 years ago and another 1,000 years ago. About 90 percent of Mount Rainier's eruptions have been in the form of lava flows. In contrast, most of the other Cascade volcanoes, including Mount St. Helens, have had a more violent history with few lava flows and a high volume of pyroclastics. Much of the ash and pumice on Mount Rainier's slopes came from Mount St. Helens during explosive episodes like the 1980 eruption. The mountain's great height and northerly location allowed glaciers to cut deeply into its volcanic deposits. The mountain and the area around it is a history of lava flows, lahars, mudflows, pyroclastic explosions, and ash falls mixed with glacial debris, glacial outwash floods, and rockfalls.

Solid rock and talus slopes with virtually no topsoil occupy the higher elevations while lower elevations are composed of glacial till. Valley bottoms contain layers of mixed rocks and benches of silt deposited by streams and glaciers. There are four main types of soils:

• Tephra soils: pyroclastic deposits

• Colluvial soils: unstable soils

• Alluvial soils: formed from river deposition, glacial outburst floods, and ephemeral streams carrying snowmelt discharge

• Mudflow soils: result of lahars Tephra soils are identified by individual ash layers and are the result of volcanic eruptions of Mount Rainier, Mount St. Helens, and to a lesser extent, Mount Mazama (the volcano that erupted about 7,000 years ago to form Crater Lake).

Colluvial soils are rapidly drained and consist of coarse, unconsolidated, mixed parent materials. These soils are found on slopes at all elevations. They are especially prevalent on steep slopes and south-facing areas. Alluvial soils are often found in major river valleys, along streams, on wet benches, and on alluvial slopes and fans. Mudflow soils are surface or subsurface parent materials within the rooting zone. Mudflow soils may contain tephra W, a volcanic ash layer from a Mount St. Helens eruption, as well as alluvial or colluvial surface deposits. T

The following chart provides a summary of the main soil types across the subject property:

Soil Type/ Map Unit	% of area	% Slope	Site Class	Site Index (50 year)
Cattcreek	33%	30-65%	IV	90

Cotteral	5%	8-65%	V	70
Cryohemist	<1%	0%	V	0
Ethania	52%	8-90%	V	70
Rock Outcrop	1%	50-90%	-	0
Rock Outcrop-Cattcreek Complex	7%	65-90%	IV	90

Soil Characteristics

CATTCREEK SERIES

The Cattcreek series consists of deep and very deep, well drained soils formed in dacitic pumice and volcanic ash over colluvium from andesite and glacial till. Cattcreek soils are on mountain slopes and cirque basins at elevations of 2,800 to 5,300 feet. Slopes range from 8 to 90 percent. The upper profile formed in aerially deposited dacitic pumice and volcanic ash from Mt. St. Helens. The lower part of the profile formed in colluvium, alluvium or glacial till from andesite with an admixture of pumice and volcanic ash. Mean annual temperature is 39 to 42 degrees F. and average annual precipitation is 90 to 120 inches including considerable snow. The growing season (28 degrees F.) is 70 to 140 days.

Typically the soils of the series are covered by a one inch matt of partially decomposed needles, twigs, and bark. The subsurface is loamy sand with pumice fragments overlying gravelly sand and andesite pebbles and cobbles. Bedrock is 40 to 60 inches deep or more.

The soils are well drained with slow to medium runoff, moderately rapid permeability in the upper profile and moderate in the buried profile. They are underlain by dense glacial till with a perched water table as high as 3.5 to 5 feet at times from November through March.

The soils of this series are used for timber production, wildlife habitat, and watershed. Vegetation is Pacific silver fir, noble fir, western hemlock, western redcedar, western white pine, Alaska-cedar, Douglas-fir, beargrass, Oregon-grape, longtube twinflower, western brackenfern, evergreen blackberry, black mountain huckleberry, princes pine, bunchberry dogwood, deer fern, red huckleberry, violet, queencup beadlily, tall blue huckleberry, and western rattlesnake plaintain.

COTTERAL SERIES

The Cotteral series consists of very deep, well drained soils that formed in slightly weathered pumiceous cinders and volcanic ash. Cotteral soils are on mountainous uplands at elevations of 2,800 to 4,900 feet. Slopes are 0 to 65 percent. The soil formed in a slightly weathered pumice mantle over sandy loam and/or silt loam high in volcanic ash. Average annual precipitation ranges from 90 to 110 inches. Mean January temperature is 28 degrees F, mean July temperature is 55 degrees F, and mean annual temperature is 41 degrees F. The growing season (28 degrees F.) is 100 to 150 days.

Typically the soils of the series are covered by a one to two inch matt of partially decomposed needles, twigs, and bark. The subsurface is sandy loam with approximately 60% pumice fragments overlying silt loam with a small component of pebbles and cobbles. The section from 10-40 inches deep contains 50 to 90 percent volcanic pumice from 2 to 50mm in size. Bedrock is 40 to 60 inches deep or more.

The soils are well drained with slow to medium runoff, moderately rapid permeability in the upper profile, very rapid in the mid profile, and moderate in the buried profile. They are underlain by dense glacial till with a perched water table as high as 3.5 to 5 feet at times from November through March.

The soils of this series are used for used for woodland, watershed, and wildlife habitat. Cover is Douglas-fir, Pacific silver fir, western hemlock, western redcedar, noble fir, Alaska cedar, and western white pine, with an understory of beargrass, red huckleberry, princes pine, western swordfern, western redcedar, noble fir, Alaska-cedar, and western white pine.

CRYOHEMISTS,

The cryohemists are not well described in the soil surveys. They occur on 0 to 2 percent slopes in cirques, depressions, and mountain valleys at an elevation of 1,000 to 2,000 feet. Average annual precipitation ranges from 70 to 120 inches. Mean annual air temperature is from 39-45 degrees. The growing season is 40 to 80 days.

Typically the soils of the series muck over mucky peat over clay loam. They are composed of organic material of volcanic ash and/or alluvium. They are very poorly drained and are frequently subject to ponding.

ETHANIA SERIES

The Ethania series consists of very deep, well drained soils formed in dacitic pumice and volcanic ash over residuum and colluvium from sandstone, andesite and glacial till. Ethania soils are on mountain ridge crests, sideslopes, and cirque basins. Slopes range from 8 to 90 percent. The Ethania soils formed in a mantle of slightly weathered pumice and cinders overlying colluvium and residuum from sandstone, andesite or glacial till. The climate is marine influenced with relatively cool, dry summers and cool, wet winters. The mean annual precipitation is 80 to 110 inches, with a large portion of it in the form of rain and snow in the winter months. The mean January temperature is about 27 degrees F, the mean July temperature is about 58 degrees F, and the mean annual air temperature is about 37 degrees F. Frost-free season is 90 to 110 days.

Typically the soils of the series are covered by a one inch matt of partially decomposed needles, twigs, and bark. The subsurface is ashy loamy sand with approximately 35% pumice fragments overlying medial loam with a small component of sandstone pebbles and cobbles changing to 50% sandstone pebbles and cobbles. The section from 4-14 inches deep contains 35 to 50 percent volcanic pumice from 2 to 10mm in size and 25 to 40 percent volcanic ash. Bedrock is 40 to 60 inches deep or more.

The soils are well drained with very rapid permeability in the pumice mantle, moderately rapid or rapid in the buried profile; slow to medium runoff. They are underlain by dense glacial till have a water table as high as 3.5 to 5 feet at times from November through March.

The soils of this series are used for used for used for timber production, wildlife habitat and watershed. Vegetation is Pacific silver fir, noble fir, western hemlock and Alaska-cedar with an understory of common beargrass, deerfern, common fireweed, huckleberry, pearly everlasting and thimbleberry.

ROCK OUTCROP

Exposed basalt

ROCK OUTCROP – CATTCREEK COMPLEX

Cattcreek soils as described above interspersed with exposed basalt.

Management Recommendations

The purpose of future management activities should be to protect and enhance soil organic matter and associated mycelium (vegetable part of fungus, cycling nutrients through the soil substrate). Conservation and enhancement of soil health is one of the primary objectives of this forest management plan.

Soil Management Standards

1. Ground-based logging will be limited on slopes >30%, and prohibited on slopes >50%.
2. Logging slash will be redistributed throughout the harvest unit.
3. Harvest entries will be limited to no more frequent than 10-year intervals.
4. Yarding distances will be limited through the use of more frequent roadside landings.
5. Logging will be limited to summer months when soil moisture is low.
6. Hardwoods will be retained and enhanced.

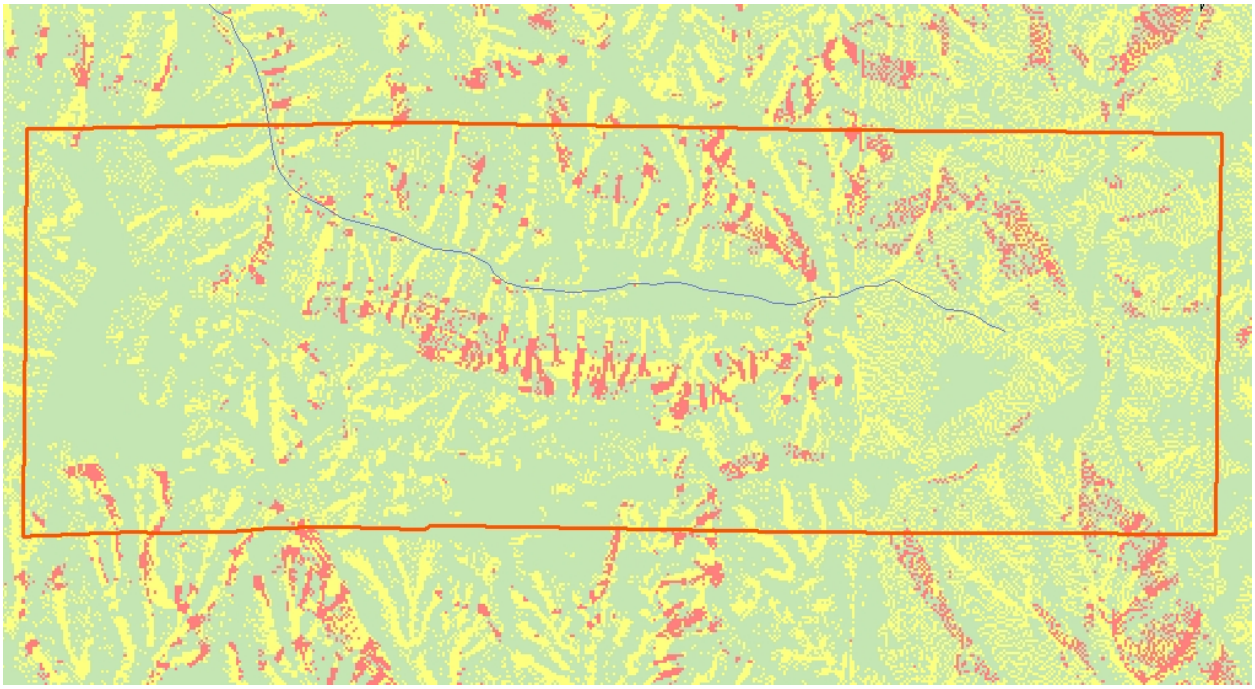
Retention of Organic Debris

During timber harvest operations, logging slash will be redistributed throughout the forest to decompose and build soil. Debris will be well distributed spatially and by size and decay class, with a goal of at least four large pieces (approximately 20" diameter x 15' length) retained per acre.

Steep Slope Restrictions

A small but significant portion of this property has steep slopes that range from 30-90 percent gradient. The soils across these areas are classified by the Natural Resource Conservation Service and the Washington State Department of Natural Resources as unstable when disturbed by harvesting, road building, or other activities.

Protecting these potentially unstable slopes can be achieved through reducing the impacts of logging activities and yarding systems. Ground-based logging will be restricted to summer months on slopes greater than 30% and prohibited on slopes greater than 50%. Cable thinning will be allowed on slopes greater than 50%.



Steep slopes of the Upper Busy Wild Unit.

Seasonal Restrictions

Forest soils can be compacted when they are wet, reducing soil tilth and exacerbating soil-borne diseases. Therefore, any activities utilizing wheeled or tracked equipment should be scheduled for the summer or fall, or other periods when soil moisture is low. Additionally, skidder passes across the soil will be minimized through the use of frequent and small log landings located along the extensive network of forest roads.

Retention of Hardwoods

Hardwood trees such as red alder, big leaf maple and cottonwood provide a significant amount of annual leaf litter and woody debris to the forest floor, which quickly rots and is incorporated into the soil. Hardwoods also provide an important role in the nutrient cycle of the forest. Therefore, existing hardwoods will be maintained and favored during forest management activities (e.g. releasing maple in the understory) and the species composition of the forest will gradually be managed to a 25:75 hardwood to conifer mix over time.

Timber Harvest and Log Yarding Methods

Commercial thinning entries will be limited on a single site to no less than 10 year intervals in order to minimize compaction of soils. No more than 30 percent of individual trees will be harvested at one time in order to minimize the potential for post-logging windthrow. Logging slash will be distributed throughout the site, vs. pile d and burned, in order to aid in soil development. Skid trails and yarding corridors will be limited to no more than 800 – 1,000 feet from harvest unit to roads or landings in order to minimize excessive skidder passes.

Hydrology

Streams of the Upper Busy Wild Unit.

Overview

The Upper Busy Wild Unit consists primarily a tributary headwaters of Busy Wild Creek. The Creek drains a large valley that runs primarily west to east. Numerous intermittent tributaries drain the valley to the Creek. Steelhead and Coho are potentially present in the unit but have not been observed or surveyed. However sediment delivered from this area can have a large adverse impact on the salmon spawning grounds lower in the system.

There is one sizeable wetland area that is underlain by Cryohemist soils. The wetland is located at the toe of a geologically recent slump

Management Recommendations

Forest management within the riparian zone of all streams, ponds and wetlands will, at a minimum, adhere to the following guidelines as set forth within the Forest Stewardship Council's U.S. Forest Management Standards.

1. Forest management will retain and recruit sufficient large, green trees; snags; understory vegetation; down logs; and other woody debris in riparian zones to provide shade, erosion control, and in-channel structures.

For Type F (fish bearing) streams, and wetlands larger than one acre, an inner buffer zone is maintained. The inner buffer is at least 50 feet wide (slope distance) from the active high water mark (on both sides) of the stream channel and increases depending on forest type, slope stability, steepness, and terrain.

Management activities in the inner buffer:

- maintains or restore the native vegetation
- are limited to single-tree selection silviculture
- retain and allows for recruitment of large live and dead trees for shade and stream structure
- retain canopy cover and shading sufficient to moderate fluctuations in water
- temperature, to provide habitat for the full complement of aquatic and terrestrial species
- native to the site, and maintain or restore riparian functions
- exclude use of heavy equipment, except to cross streams at designated places, or
- where the use of such equipment is the lowest impact alternative
- avoid disturbance of mineral soil; where disturbance is unavoidable, mulch and seed
- are applied before the rainy season
- avoid the spread of pathogens3 and noxious weeds
- avoid road construction and reconstruction

For wetlands larger than one acre, an outer buffer zone is maintained. This buffer extends from the outer edge of the inner buffer zone to a distance of at least 150 feet from the edge of the active high water mark (slope distance, on both sides) of the stream channel. In this outer buffer, harvest occurs only where:

- single-tree or group selection silviculture is used
- post harvest canopy cover maintains shading sufficient to moderate fluctuations in water
- temperature, provide habitat for the full complement of aquatic and terrestrial species
- native to the site, and maintain or restore riparian functions
- new road construction is avoided and reconstruction enhances riparian functions and
- reduces sedimentation
- disturbance of mineral soil is avoided; where disturbance is unavoidable, mulch and
- seed are applied before the rainy season

For Np streams, a 25-foot (slope distance) inner buffer is created and managed according to provisions for inner buffers for Type F&S waters. A 75-foot (slope distance) outer buffer (for a total buffer of 100 feet) is created and managed according to provisions for outer buffer for Type F&S waters.

For Ns streams that support aquatic species, and for wetlands smaller than one acre, a buffer zone 75 feet wide (on both sides of the stream) is established that constrains management activities to those that are allowed in outer buffer zones of Type F&S streams.

- For Ns streams that do not support aquatic species, management:
- maintains root strength and stream bank and channel stability
- recruits coarse wood to the stream system
- minimizes management-related sediment transport to the stream system

Forest Resources

Overview

The Upper Busy Wild unit is currently mostly unbroken second growth forest in the 30-50 year age range. The predominant species are Silver Fir, Noble Fir, Grand Fir, Western Hemlock, and Douglas Fir with a mix of a few other species.

Desired Future Condition

The desired future condition for the Nisqually Community Forest is as a working forest that produces a sustained yield of high value forest products while providing optimal wildlife habitat and ecosystem services. Within the context of a working forest, this forest will be managed to restore structures and habitat functions associated with late successional, or "old-growth" forests. Within this goal is a need to restore and/or emulate natural small-scale disturbance processes inherent in old-growth landscapes (e.g. small patch cuts that emulate the effects of wind throw) that provide patches of early-successional habitat within a mosaic of older forest stands and riparian areas. This landscape diversity can provide forage and nesting habitat for a wide range of wildlife species.

Criteria associated with old-growth forests can provide useful guidance toward achieving these conditions. In general, increases in overstory tree species diversity, size and age class distributions of trees, understory vegetation diversity and abundance, and large volumes of large snags and downed wood are generally desirable. However, composition, structure, and productivity of forest stands is often driven by past management and site-specific conditions; thus no single measure is generally sufficient. Nor is it reasonable to expect that a full complement of all old-growth attributes is realistic, achievable, or desirable for all stands. The following six key structural elements are generally recognized as being representative of old-growth forests:

a. Large trees (trees exceeding 40" diameter at breast height) of mixed species diversity
b. Large snags (dead trees exceeding 20" dbh and 50' tall)
c. Large volumes of downed woody debris
d. Tree size diversity
e. Trees of mixed age
f. Forest canopy gaps

These elements are generally correlated with other attributes of complex forest structure such as spatial heterogeneity (e.g. variable stocking and multiple tree heights), broken-topped crowns, and the presence of shade-tolerant tree species.

Forest Carbon

Carbon opportunities will begin to be assessed during future site visits.

Annual Allowable Harvest

The annual allowable cut (AAC) refers to the volume of timber that may be harvested annually, on average, during a given period to maintain sustained production. The AAC is based on the productive capacity of the forest, as determined either by soil productivity rates or periodic forest inventories, and is generally assumed to be a volume of timber that is less than the annual growth rate of the forest.

Silvicultural Guidelines

The Community Forest will utilize an *uneven-aged, structure-based forest management* approach to restoring and managing their forests. Structure-based management (SBM) prescribes a mix of active forest management techniques that produce an array of forest stand structures across the landscape - from areas where new trees are being established, to older forest structure featuring late seral, or "old growth", characteristics such as numerous large trees, multi-layered canopies, and substantial numbers of down logs and large snags. Individual stand types may change constantly through management and natural disturbance, but the range of stand types and their relative abundance across the land base is relatively stable. Because the forest structures are in a dynamic balance across the landscape, the forest provides a steady flow of forest products, habitats, clean air and clean water.

Using an SBM approach, stand density is actively managed to accelerate successional development while simulating natural conditions and disturbance regimes. This is accomplished through a combination of variable density and variable density thinning. SBM techniques can be used to produce a variety of results. Some prescriptions will result in fast-growing, well-stocked stands with higher structural homogeneity. Other prescriptions will develop more complex stand structures, with rapid tree diameter growth, enough sunlight on the forest floor to maintain understory plants and natural tree seedling regeneration, and a complex forest canopy. Thinning can also be used to create or maintain other important structural components, such as snags, down wood, legacy trees, gaps in the canopy, and multiple canopy layers.

A diversity of stand types provides for a broad range of ecosystems and biodiversity -- including a wide range of wildlife habitats. The structural components associated with these diverse stand types benefit long-term forest productivity by maintaining key linkages for nutrient cycling and soil structure and health. The high level of biodiversity and structural heterogeneity should result in a more resilient forest that will be less prone to large-scale disturbances such as fire, wind and ice storms, as well as climatic stresses.

Carey (1998) defines four key structuring processes that contribute to greater habitat diversification:

a. Crown class differentiation: competition among trees of the same age results in dominant, codominant, subordinate, and suppressed trees.
b. Decadence: trees get damaged, infected with fungi, break down, and recycle within the ecosystem.
c. Understory development: variability in light, temperature, and soil moisture promotes structurally-diverse growth on the forest floor.
d. Canopy stratification: trees of different ages and growth habits produce multiple layers of vegetation, including a well-developed midstory.

Providing for these four key processes can lead to two primary levels of structural complexity within a forest - individual and stand level. Examples include:

a. Individual structures
    1. Trees of diverse heights, diameters, branch sizes, and bark characteristics
    2. Large, dead standing trees (snags)
    3. Coarse woody debris (stumps and logs) in various states of decay

b. Stand-level structures
    1. Vertical heterogeneity: ever-changing distributions of foliage from the forest floor to the tree tops
    2. Horizontal heterogeneity: patchiness in the overstory, midstory, and understory

Additionally, Carey identifies two key processes influencing vegetative species composition that can lead to greater habitat diversification:

a. Development of habitat breadth: patchy canopies produce variability in light, temperature, and soil moisture, leading to patches of different types in the understory.
b. Pre-interactive niche diversification: expansion in forest structure and plant species composition provides diverse niches for animals, plants, and fungi; additional niche diversification occurs after species interact.

Complex forest structure and complex species composition lead to greater complexity in forest function. Primary benefits of more complex forest function include:

a. High carrying capacities for diverse animals
b. High productivity for plants
c. Effective regulation of nutrients and water cycling
d. Healthy, resilient forests

Application of Ecological Forestry

The Community Forest will employ ecological forestry strategies that, within the context of a working forest, emphasize maintenance and restoration of physical and ecological processes associated with late seral, or old-growth, forests. Restoration of old-growth structure, composition, and ecological functions (e. g. habitat) in young-managed forests has become an increasingly prominent management objective throughout the Pacific Northwest coastal region over the past 20 years. The possible role for silvicultural intervention in achieving this objective is now a common theme for scientific research. From this research, a suite of silvicultural tools are emerging that appear to be useful in achieving this objective, including thinning (manipulation of stand densities and species composition), creation of canopy gaps and undisturbed leave islands (“skips”), girdling, topping, and/or dropping of overstory trees, and underplanting of tree species.

The field of ecological forestry and the use of silvicultural tools for improving the ecological functions of forests while balancing needs to produce timber and generate revenue are relatively new concepts. Most research is still in the early stages. The list below highlights the key concepts that will be utilized across the Community Forest.

a. Thinning that retains non-dominant conifers and hardwood species, and enhances tree crown growth resulting in reduction of height to diameter ratios, will likely help forests become more resistant to wind disturbance and shift the landscape from high to a low severity wind disturbance regime.
b. Thinning combined with gap creation and underplanting that increases the species and age class diversity of the stand will likely result in stands that are more resilient to high-severity wind disturbance, pest/pathogen outbreaks, and unforeseen changes resulting from climate change.

c. Large trees and branches are important components of old-growth habitat; thinning to release dominant trees will likely spur diameter and branch growth. In addition, single-tree selection to create or enhance desirable habitat traits is likely to increase development of old-growth structures.
d. Thinning that is spatially variable, retains pairs and clumps of trees, and enhances species diversity through retention of non-dominant conifers and hardwoods is more likely to enhance forest habitat complexity. This can likely accelerate development of structures and conditions associated with old-growth biodiversity faster than in unthinned areas or more evenly thinned areas.
e. Creation and recruitment of snags and large woody debris following thinning. These are critical ecological components, and if stands are lacking these structures, mechanical creation of them during thinning operations should be considered. Their recruitment should also be monitored over time. If natural recruitment following thinning is insufficient, efforts should be made to increase the abundance and distribution of these structural features at varying stages of decay on the landscape through mechanical means.
f. Protection of existing understory vegetation, particularly older tall shrubs, should be included in the operational layout to retain the important biological structure and habitat that this layer provides. Loss of ecological functions resulting from damage of existing vegetation, especially tall shrubs, can take decades to recover.
g. Large “gaps” or openings should be used in some areas to increase the age and diversity of tree species and provide natural early-seral habitat and forage on the landscape.
h. Unstable slopes should generally be protected or harvested with minimal ground disturbance and light thinning. Exceptions may arise in areas where intentional creation of large-diameter trees in mass wasting zones is carefully planned. In general, ground-based logging will be limited on slopes greater than 30 percent, and prohibited on slopes greater than 50 percent.
i. Inclusion of leave areas (“skips”) of varying sizes should be considered to protect sensitive aquatic areas (e. g. , seeps, forested wetlands), unstable slopes), structural features (e. g. , large shrubs), and species that may be dispersal limited or otherwise sensitive to ground disturbance or canopy openings (e. g. , lichens, fungi, amphibians). Additionally, the spatial configuration of the leave areas can be designed to assist sensitive species.

Some large contiguous areas or stands should likely remain unthinned to retain diversity on the landscape, to protect against unforeseen negative outcomes of thinning, and to provide refugia for certain species with wide dispersal abilities that are sensitive to disturbance or open canopies (e. g. flying squirrels, Hermit thrush).

FSC Guidelines

The Nisqually Community Forest is committed to managing its forests to the highest silvicultural standards in the world as certified by the FSC. The following chart of generalized silvicultural prescriptions has been extrapolated from the FSC U. S. Forest Management Standards and applies to all forest stands where active forest management activities will take place.

Prescription	FSC Criteria
If patch cuts exceed 6 acres in size, 10-30% of pre-harvest basal area will be retained following harvest. The levels of green-tree retention will depend on such factors as: opening size, legacy trees, and adjacent riparian zones, slope stability, upslope management, presence of critical refugia, and extent and intensity of harvesting across the forest management unit. Retention will be distributed as clumps and dispersed individuals, appropriate to site conditions. Retained trees will comprise a diversity of species and size classes, which includes large and old trees.	6. 3. e. 5.
Streams, vernal pools, lakes, wetlands, seeps, springs, and associated riparian areas are managed to maintain and/or restore hydrologic processes, water quality, and habitat characteristics. Forested riparian buffers will be maintained around all rivers, streams, ponds and wetlands as per the guidance provided in this FMP.	6. 5. m
Legacy trees, old and large trees, snags and woody debris will be retained (or, if absent, recruited) to sustain populations of native plants, fungi, and animals, both within the harvest unit and across the forest management unit.	6. 3. e. 1.
Habitat components necessary to support native species (e. g. vertical and horizontal structural complexity, understory species diversity, food sources, nesting, denning, hibernating, and roosting structures, habitats and refugia for sedentary species and those with special habitat requirements) will be protected, maintained, and/or enhanced within each harvest unit and across the entire forest management unit.	6. 3. b. 3
Where necessary to protect against wind throw and to maintain microclimate, green trees and other vegetation are retained around snags, down woody debris, and other retention components.	6. 3. e. 2.
Native hardwoods and understory vegetation will be retained as needed to maintain and/or restore the natural mix of species and forest structure.	6. 3. e. 3.
Live trees and native understory vegetation will be retained within the harvest unit in proportions and configurations that are consistent with the characteristic natural disturbance regime in each community type, unless retention at a lower level is necessary for purposes of restoration.	6. 3. e. 4.
Logging operations and the use of roads and skid trails occur only when soil compaction, erosion, and sediment transport do not result in degradation of water quality, site productivity, or habitats.	6. 5. a.
Silvicultural systems, integrated pest management, and strategies for controlling pests and/or unwanted vegetation will be developed that result in the least adverse environmental impact, with the goal of reducing or eliminating chemical use.	6. 6. b.
All major forestry operations (e. g. thinning, road building, etc.) will primarily occur outside the primary bird breeding season (April 15^{th} – June 15^{th}).	BMP

Forest management criteria from the FSC U.S. forest management standards

Timber Harvest Methods

Thinning

The central feature of the forest management prescriptions outlined in this plan is the application of thinning techniques. When thinning, stands will first be thinned *from below* to reduce stocking density and create a spacing pattern that will allow the residual trees to optimize their growth potential. This approach to thinning will employ a "best tree selection" method where the healthiest and most dominant trees of all species are retained within the stand. Groups of trees in root rot pockets, as well as poorly performing sites will be targeted for removal. This combination of thinning from below and group tree selection, also called "skip and gap" harvesting, will result in a highly variable structure to the forest with small openings (gaps), small patches of dense trees (skips) and otherwise a generally well-spaced stand throughout. This approach will set all stands on a trajectory to achieve greater spatial, structural and species diversity than the stands would have achieved if left unmanaged.

Thinning Techniques

Pre-commercial thinning

Pre-commercial thinning is recommended for both younger stands that exceed 350 tpa after canopy closure, and older stands where there is robust natural regeneration of conifers in the understory. Forest stands that exceed this density will typically enter the stem exclusion phase between the ages of 10 – 20 years, depending largely on soil productivity. This phase is characterized by a dense canopy with sufficient shade to kill lower branches, suppress understory vegetation, and lead to suppression-based mortality of non-dominant trees. Live crowns gradually begin receding, and once they diminish below 35

Timber Management Standards

1. Thinning volume: No more than 30% of the individual trees (~20 – 25% of volume) will be harvested during a commercial thinning.
2. Clearcuts: Regeneration harvests (aka clearcuts) will not exceed 6 acres, and must retain as many snags, downed logs and understory trees as operationally feasible. Regeneration harvests must be replanted within 12 months to a mix of species including (research appropriate species mix), and a minimum survival of 200 tpa must be ensured by the third year.
3. Legacy trees: 50 – 75 tpa (75/25 conifer/ hardwood) of a minimum 36" dbh will be retained as permanent legacy trees. Legacy trees will be well dispersed as individuals and in clumps.
4. Old-growth: all current old-growth trees (>48" and/or >150 years old) will be permanently retained, and a minimum 50' equipment limitation zone will apply in a radius around each tree.
5. Hardwoods and Conifers: Forest will be managed towards a species mix of 75 percent conifer and 25 percent hardwood (appropriate at this elevation?). Hardwoods will be well dispersed, both as individuals and in clumps, across each FMU.
6. Snags and downed logs: All snags >12" dbh, and all downed logs >20" dbh will be protected during timber harvest activities. Each FMU will be managed towards a consistent stocking of 4 – 10 snags and 5 – 15 downed logs per acre. Snags and downed logs should be well dispersed across the FMU, with higher concentrations occurring within the RMZ of streams and wetlands.
7. Slopes: ground-based logging equipment will only be allowed on slopes >30% during summer months. No ground-based equipment will be allowed on slopes >50%.

- 40 percent, the growth of the tree shifts from girth production to height production as trees compete for sunlight. In order to keep these stands in optimum growth, and to minimize the risk for natural disturbance, they should be pre-commercially thinned.

The object of pre-commercial thinning is not to maintain an even spacing amongst all trees, but rather to favor healthy trees, across all species, that have dominant crowns and good log quality - a technique referred to as "best tree selection". Stands exceeding 350 tpa should be thinned to 350 tpa. The first thinning of a stand typically occurs "from below", selecting the smaller diameter, suppressed and poorest quality trees first. Thinning in this manner typically results in a variable density spacing amongst retained trees that averages approximately 11 feet.

Trees should be cut within six inches of the ground using either a chainsaw or handheld saw. Cut trees should be brought down so they are not leaning on the retained trees. Care should be taken not to damage the trunk of leave trees during thinning. It is crucial that the best trees within a given area be left, rather than rigid adherence to an exact spacing requirement. If high quality leave trees occur in close proximity to each other, they may be left as a clump to help ensure stability against wind disturbances. Leave trees shall be those that have the largest live crown, tallest height, straightest stem, and show no signs of defect (e.g. broken tops, scars, leaning, wane, etc.). The resulting slash can be piled into habitat piles measuring a minimum of 10 ft. across and 6 ft. high and/or downed logs measuring a minimum of 20 ft. long and 20 in. in diameter, cut into firewood and removed, piled and burned, chipped, or any combination thereof. Thinning should be avoided during the prime bird nesting season between March 15th – June 30th.

Commercial Thinning from Below

Thinning from below is a technique typically used during the first commercial thinning entry in a stand. Approximately one-third of the overall trees (~25% of the volume) are removed. Harvest tree selection is from the suppressed and intermediate canopy classes, in order to promote the growth of the co-dominant and dominant trees. Best tree selection methods are used similar to pre-commercial thinning. This means that co-dominant or dominant trees may be removed if they have defect or will release more desirable species in the understory. Thinning is across the species, retaining the best quality tree of each species, both hardwood and conifer. Sufficient hardwoods will be retained to move the stand towards target of ??% stocking by hardwood. All trees exceeding 32 inches dbh, regardless of species, will be retained as legacy trees during at least the first commercial thinning entry. If pre-thinning stand density is approximately 300 - 350 tpa, then stands will be thinned to approximately 200 – 250 tpa.

Commercial Variable Density Thinning

Variable density thinning techniques are typically employed during the second and third thinning entries of a stand. Variable density thinning involves varying the thinning intensity to produce a mosaic of unthinned, moderately thinned, and heavily thinned patches. Thinning with skips and gaps can also create this mosaic. Variable density thinning helps generate a more complex forest structure by promoting tree growth at different rates. It also encourages understory development through a diversity of species, a variety of patch types, and growth of tree seedlings and saplings. Variable-density thinning can improve forest health by increasing (a) resistance to disturbance, (b) ability to recover after disturbance, and (c) biological diversity that allows ecosystems to function well through climatic variation.

Variable density thinning typically occurs across both species and diameters, reducing stand density by no more than one-third of the standing trees per entry. Sufficient hardwoods will be retained to move the stand towards target of 25% stocking by hardwood. If stand density is approximately 200 – 250 tpa, then the 2nd entry will reduce the density to 120 – 160 tpa. During the third entry thinning, stand density will be reduced further to approximately 90 – 105 tpa. The following thinning entry will likely follow variable retention harvesting methods as per below. When selecting trees for harvest, most thinning is still conducted from below. However, dominant overstory trees may be selected for harvest if they will release a vigorous understory tree that has ample live crown. Thinning in this manner produces a more complex forest canopy and stimulates natural regeneration in the understory, thereby minimizing the need for manual planting.

Following second and third thinning entries, an inventory of naturally regenerating trees in the understory will be conducted. If less than 100 tpa are naturally regenerating across multiple species and ages, then manual planting will be used to increase stocking and even distribution across the FMU.

Commercial Variable Retention Harvest

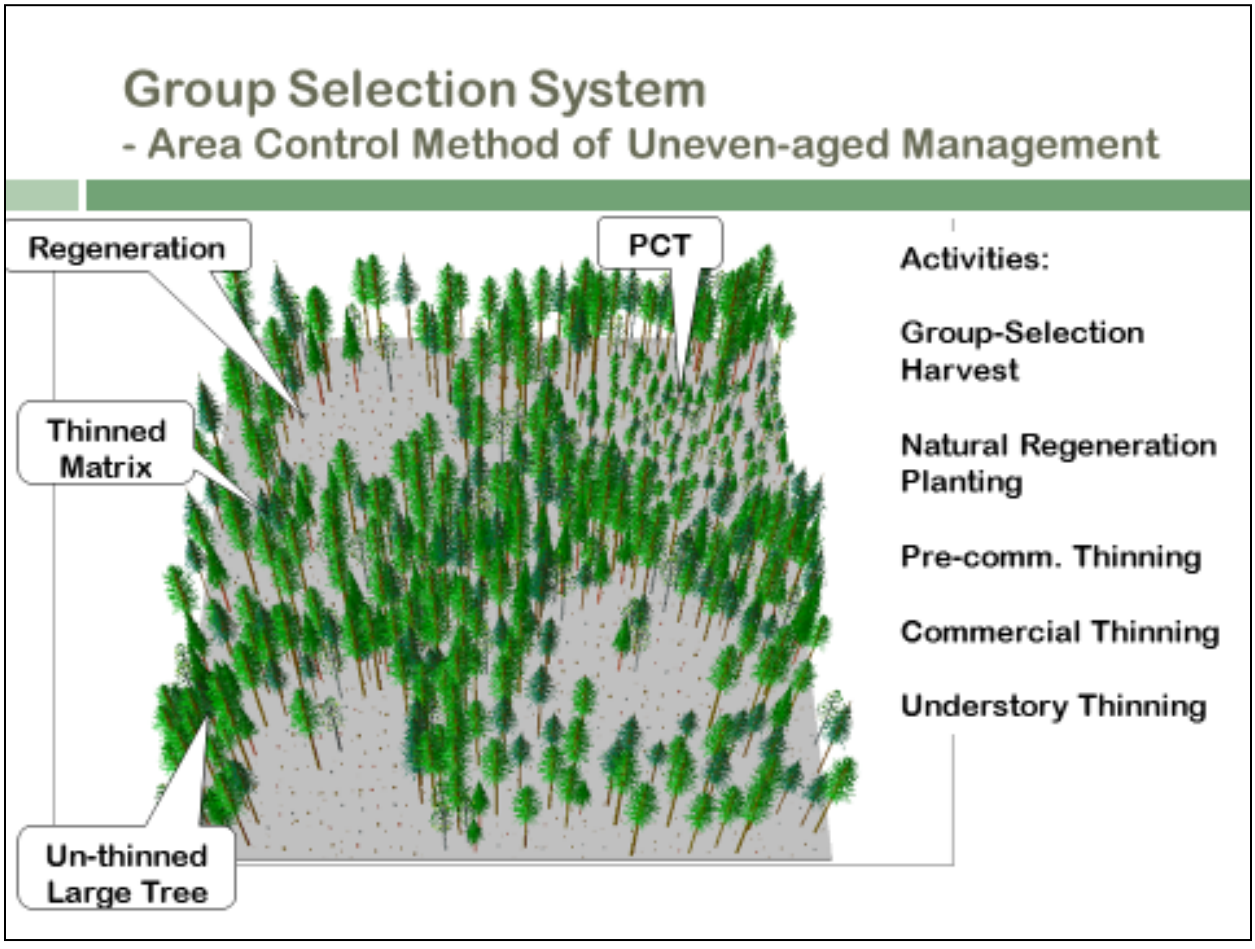
Variable retention harvesting (VRH) is typically applied to older, previously thinned stands during the third or fourth harvest entry. During a VRH, most of the dominant and co-dominant trees are removed, with the exception of 50 – 75 dominant tpa of both hardwoods and conifers. These leave trees will be retained as permanent biological legacies, whether standing or downed. VRH objectives include providing habitat for wildlife and retaining some of the original forest floor, including shrubs, plants, and populations of beneficial mycorrhizal fungi. Retaining these "biological legacies" enhances the diversity of plant and animal life in the regenerating forest stand over a long time. Operationally, VRH must plan for future access to avoid injuring trees that are left on the site forever. Because the economic value of retained trees will not be realized, poor quality (from a market perspective) trees are typically chosen for retention.

If, during previous harvests, the stand was thinned using variable density thinning techniques, then there may be sufficient natural regeneration in the understory to avoid manually replanting the site. A post-harvest inventory must be made to quantify the species and stocking density to determine if the stand has a desirable composition. If planting will be used to regenerate the stand, retaining large, limby trees with thick, tapered boles reduces the likelihood of blow down. Trees with forked or dead tops are also good candidates for retention. These "defective" trees provide perching or nesting habitat for a variety of birds and small mammals.

Following VRH, an inventory of naturally regenerating trees in the understory will be conducted. If less than 200 tpa are naturally regenerating across multiple species and ages, then manual planting will be used to increase stocking and even distribution across the FMU.

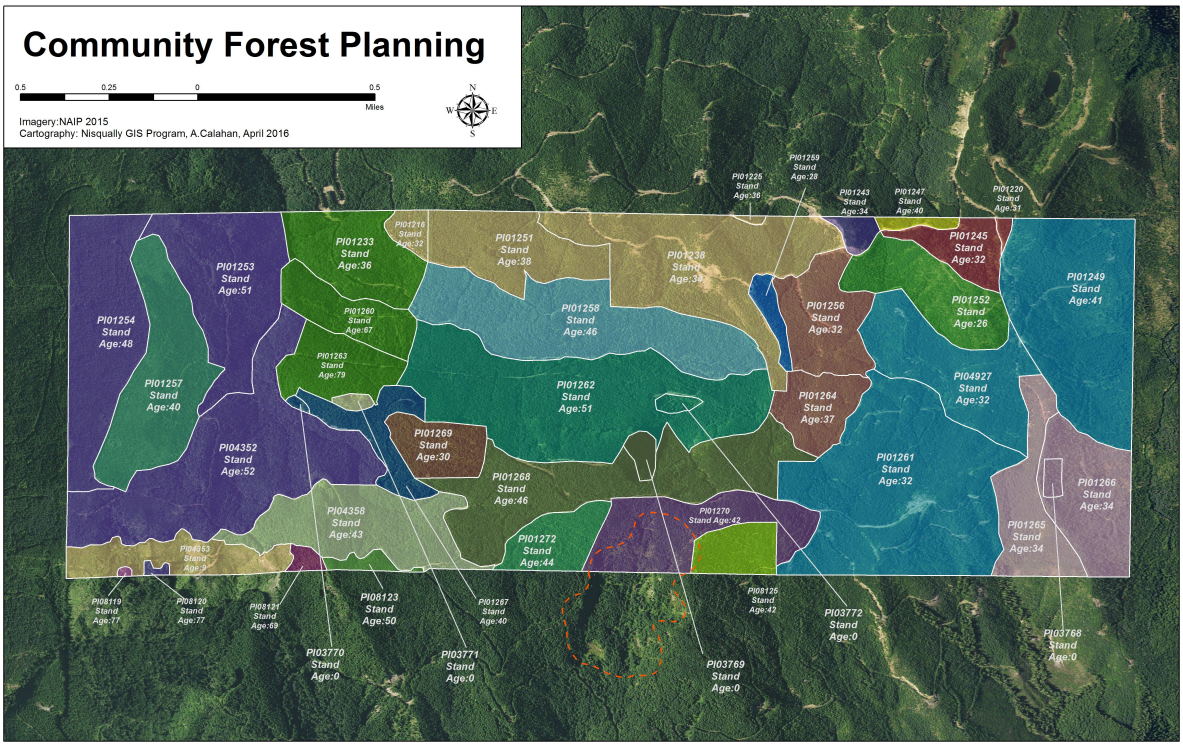
Commercial Regeneration (aka clearcut) Harvesting

A regeneration harvest is typically applied to older stands where the regeneration of a new cohort of trees is desired, or in places where disease, storm damage or other natural disturbance events have severely damaged timber quality, and salvage harvesting is desired to recover the value of the timber. Regeneration harvests of up to 6-acres will be allowed where all merchantable timber may be removed. Within regeneration harvest openings larger than 6 acres, 10-30 percent of pre-harvest basal area will be retained as per guidelines under variable retention harvesting above. The levels of green-tree retention will depend on such factors as: opening size, legacy trees, adjacent riparian zones, slope stability, upslope management, presence of critical refugia, and extent and intensity of harvesting across the FMU. Retention is distributed as clumps and dispersed individuals, appropriate to site conditions. Retained trees comprise a diversity of species and size classes, which includes large and old trees. Regeneration harvests must be replanted within 12 months to a mix of species including Douglas fir, western red cedar, western hemlock, red alder and big leaf maple, and a minimum survival of 200 tpa must be ensured by the third year.



Example of various timber management techniques that combine to create an uneven-aged management regime. Graphic from Rolf Gersonde, Seattle Public Utilities.

FMU Descriptions & Management Recommendations



Forest Management Units of the Upper Busy Wild Unit. Units are delineated by color with the prvious landowners unit delineated by the white lines

FMU 1:

FMU 1 is 100 acres and the site index is 74. Currently FMU 1 is a 36 year old plantation. There are an average of 938 trees per acre with Noble Fir being the predominant species. Western Hemlock and Silver Fir are also present in significant numbers. Douglas fir and Red Alder are also present as minor components of the stand. The trees of the stand have an average DBH of 6.2 inches and an average height of 30 feet. The Silver Fir are the largest with an average DBH of 7.9 inches and an average height of 36 feet.

FMU 1 will be pre-commercial thinned in 2016-2021 and then will be commercial thinned starting in 2031-2036 with repeated entries every 15 years.

FMU 2

FMU 2 is 408 acres and the site index is 87.5. Currently FMU 2 is a 35 year old plantation. There are an average of 402 trees per acre with Silver Fir being the predominant species. Noble Fir, Western Hemlock, Douglas Fir, and Red Cedar are also present as minor components of the stand. The trees of the stand have an average DBH of 8.5 inches and an average height of 37 feet. The Silver Fir are the largest with an average DBH of 9.1 inches and an average height of 40 feet.

FMU 2 will be commercial thinned starting in 2026-2031 with repeated entries every 15 years.

FMU 3

FMU 3 is 49 acres and the site index is 92. Currently FMU 3 is a 28 year old plantation. There are an average of 376 trees per acre with Noble Fir and Western Hemlock being the predominant species. Douglas fir is also present as a minor component of the stand. The trees of the stand have an average DBH of 3.2 inches and an average height of 16 feet. The Douglas Fir are the largest with an average DBH of 4 inches and an average height of 20 feet.

FMU 3 will be will be commercial thinned starting in 2036-2041 with repeated entries every 15 years.

FMU 4

FMU 4 is 24 acres and the site index is 93.5. Currently FMU 4 is a 34 year old plantation. There are an average of 428 trees per acre with Silver Fir and Noble Fir being the predominant species. Douglas Fir is also present in significant numbers. Western Hemlock and Mountain Hemlock are also present as minor components of the stand. The trees of the stand have an average DBH of 8.3 inches and an average height of 37 feet. The Silver Fir are the largest with an average DBH of 9.2 inches and an average height of 42 feet.

FMU 4 will be commercial thinned starting in 2026-2031 with repeated entries every 15 years.

FMU 5

FMU 5 is 5 acres and the site index is 74. Currently FMU 5 is a 42 year old plantation. There are an average of 1,550 trees per acre with Silver Fir being the predominant species. Western Hemlock is also present as a minor component of the stand. The trees of the stand have an average DBH of 7.5 inches and an average height of 40 feet. The Western Hemlock are the largest with an average DBH of 10.8 inches and an average height of 41 feet.

FMU 1 will be pre-commercial thinned in 2016-2021 and then will be commercial thinned starting in 2031-2036 with repeated entries every 15 years.

FMU 6

FMU 6 is 7 acres and the site index is 74. Currently FMU 6 is a 36 year old plantation. There are an average of 317 trees per acre with Noble Fir being the predominant species. Western Hemlock is also present. The trees of the stand have an average DBH of 5.8 inches and an average height of 33 feet. The Noble Fir are the largest with an average DBH of 6.3 inches and an average height of 32 feet.

FMU 6 will be commercial thinned in 2031-2036 with repeated entries every 15 years.

FMU 7

FMU 7 is 73 acres and the site index is 84. Currently FMU 7 is a 36 year old plantation. There are an average of 1981 trees per acre with Silver Fir, being the most numerous species and with Noble Fir and Western Hemlock present in significant numbers. Douglas fir and Red Alder are also present as minor components of the stand. The trees of the stand have an average DBH of 6.8 inches and an average height of 39 feet. The Douglas Fir are the largest with an average DBH of 8.2 inches and an average height of 50 feet.

FMU 7 will be pre-commercial thinned in 2016-2021 and then will be commercial thinned starting in 2031-2036 with repeated entries every 15 years.

FMU 8

FMU 8 is 173 acres and the site index is 91. Currently FMU 8 is a 37 year old plantation. There are an average of 384 trees per acre with Douglas Fir being the predominant species. Western Hemlock is also present in significant numbers. Noble Fir, Silver Fir, Red Alder, and Red Cedar are also present as minor components of the stand. The trees of the stand have an average DBH of 8.8 inches and an average height of 46 feet. The Douglas Fir are the largest with an average DBH of 9.6 inches and an average height of 53 feet.

FMU 8 will be commercially thinned in 2031-2036 with repeated entries every 15 years.

FMU 9

FMU 9 is 59 acres and the site index is 105. Currently FMU 9 is a 44 year old plantation. There are an average of 316 trees per acre with Silver Fir being the predominant species. Western Hemlock and Douglas fir are also present as minor components of the stand. The trees of the stand have an average DBH of 10.9 inches and an average height of 55 feet. The Douglas Fir are the largest with an average DBH of 15.9 inches and an average height of 94 feet.

FMU 9 will be commercial thinned starting in 2021-2026 with repeated entries every 15 years.

FMU 10

FMU 10 is 8 acres and the site index is 84. Currently FMU 10 is a 30 year old plantation. There are an average of 547 trees per acre with Noble Fir being the predominant species. Mountain Hemlock, Yellow Cedar, Douglas fir, and Red Alder are also present as minor components of the stand. The trees of the stand have an average DBH of 2.2 inches and an average height of 15 feet. The Mountain Hemlock are the largest with an average DBH of 2.7 inches and an average height of 19 feet.

FMU 10 will be pre-commercial thinned in 2016-2021 and then will be commercial thinned starting in 2031-2036 with repeated entries every 15 years.

FMU 11

FMU 11 is 20 acres and the site index is 90. Currently FMU 11 is a 44 year old plantation. There are an average of 233 trees per acre with Siler Fir and Douglas Fir being the predominant species. Noble Fir and Western Hemlock are also present as minor components of the stand. The trees of the stand have an average DBH of 10.5 inches and an average height of 30 feet. The Doulas Fir are the largest with an average DBH of 11.5 inches and an average height of 55 feet.

FMU 11 will be commercial thinned starting in 2026-2031 with repeated entries every 15 years.

FMU 12

FMU 12 is 112 acres and the site index is 80. Currently FMU 12 is a 48 year old naturally regenerated stand. There are an average of 285 trees per acre with Douglas Fir being the predominant species. Noble fir, Western Hemlock, and Silver Fir are also present as minor components of the stand. The trees of the stand have an average DBH of 11.4 inches and an average height of 55 feet. The Silver Fir are the largest with an average DBH of 12.3 inches and an average height of 57 feet.

FMU 12 will be commercial thinned starting in 2026-2031 with repeated entries every 15 years.

FMU 13

FMU 3 is 157 acres. and the site index is 80. Currently FMU 13 is a 53 year old naturally regenerated stand. There are an average of 322 trees per acre with Western Hemlock being the predominant species. Silver Fir is also present in significant numbers. Douglas fir and Noble Fir are also present as minor components of the stand. The trees of the stand have an average DBH of 12.6 inches and an average height of 66 feet. The Douglas Fir are the largest with an average DBH of 13.6 inches and an average height of 76 feet.

FMU 1 will be commercial thinned starting in 2021-2026 with repeated entries every 15 years.

FMU 14

FMU 14 is 106 acres and the site index is 100. Currently FMU 14 is a 48 year old naturally regenerated stand. There are an average of 363 trees per acre with Western Hemlock being the predominant species. Silver Fir are also present in significant numbers. Douglas fir, Red Alder, Red Cedar, and Noble Fir are also present as minor components of the stand. The trees of the stand have an average DBH of 12.5 inches and an average height of 61 feet. The Douglas Fir are the largest with an average DBH of 14.7 inches and an average height of 78 feet.

FMU 14 will be pre-commercial thinned in 2016-2021 and then will be commercial thinned starting in 2016-2021 with repeated entries every 15 years.

FMU 15

FMU 15 is 26 acres and the site index is 90. Currently FMU 15 is a 46 year old plantation. There are an average of 267 trees per acre with Douglas Fir being the predominant species. Western Hemlock, Silver Fir, Red Alder, and Noble Fir are also present as minor components of the stand. The trees of the stand have an average DBH of 12 inches and an average height of 30 feet. The Noble Fir are the largest with an average DBH of 19.9 inches and an average height of 96 feet.

FMU 15 will be commercial thinned starting in 2021-2026 with repeated entries every 15 years.

FMU 16

FMU 16 is 25 acres and the site index is 87. Currently FMU 16 is a 32 year old plantation. There are an average of 233 trees per acre with Douglas Fir being the predominant species. Western Hemlock, Silver Fir, and Mountain Hemlock are also present as minor components of the stand. The trees of the stand have an average DBH of 9.6 inches and an average height of 48 feet. The Douglas Fir are the largest with an average DBH of 9.9 inches and an average height of 48 feet.

FMU 16 will be commercial thinned starting in 2026-2031 with repeated entries every 15 years.

FMU 17

FMU 17 is 69 acres and the site index is 110. Currently FMU 17 is a 45 year old plantation. There are an average of 822 trees per acre with Silver Fir being the predominant species. Western Hemlock, Douglas fir, and Red Alder are also present as minor components of the stand. The trees of the stand have an average DBH of 9.9 inches and an average height of 60 feet. The Western Hemlock are the largest with an average DBH of 10.7 inches and an average height of 66 feet.

FMU 17 will be pre-commercial thinned in 2016-2021 and then will be commercial thinned starting in 2031-2036 with repeated entries every 15 years.

FMU 18

FMU 18 is 27 acres and the site index is 80. Currently FMU 18 is a 42 year old plantation. There are an average of 317 trees per acre with Douglas Fir being the predominant species. Silver Fir is also present in significant numbers. Western Hemlock is also present as minor components of the stand. The trees of the stand have an average DBH of 10.5 inches and an average height of 64 feet. The Douglas Fir are the largest with an average DBH of 11 inches and an average height of 71 feet.

FMU 18 will be commercial thinned starting in 2026-2031 with repeated entries every 15 years.

FMU 19

FMU 19 is 6 acres and the site index is 111. Currently FMU 19 is a 52 year old naturally regenerated stand. There are an average of 549 trees per acre with Western Hemlock being the predominant species. Silver Fir are also present in significant numbers. Douglas fir, Red cedar, Red Alder,

Cottonwood, and Noble Fir are also present as minor components of the stand. The trees of the stand have an average DBH of 11.7 inches and an average height of 69 feet. The Noble Fir are the largest with an average DBH of 26.8 inches and an average height of 115 feet.

FMU 19 will be commercial thinned starting in 2016-2021 with repeated entries every 15 years.

FMU 20

FMU 20 is 67 acres and the site index is 91. Currently FMU 20 is a 75 year old naturally regenerated stand. There are an average of 598 trees per acre with Western Hemlock being the predominant species. Silver Fir are also present in significant numbers. Red Alder, Douglas fir, and Cottonwood and are also present as minor components of the stand. The trees of the stand have an average DBH of 10.9 inches and an average height of 59 feet. The Cottonwood are the largest with an average DBH of 12.5 inches and an average height of 71 feet.

FMU 20 will be commercial thinned starting in 2016-2021 with repeated entries every 15 years.

FMU 21

FMU 1 is 308 acres and the site index is 83. Currently FMU 21 is a 52 year old naturally regenerated stand. There are an average of 363 trees per acre with Silver Fir being the predominant species. Western Hemlock is also present in significant numbers. Douglas fir, Red Alder, and Noble Fir are also present as minor components of the stand. The trees of the stand have an average DBH of 12.5 inches and an average height of 61 feet. The Douglas Fir are the largest with an average DBH of 13.6 inches and an average height of 72 feet.

FMU 21 will be commercial thinned starting in 2016-2021 with repeated entries every 15 years.

FMU 22

FMU 22 is 4 acres and the site index is 83. Currently FMU 22 is a 71 year old naturally regenerated stand. There are an average of 363 trees per acre with Western Hemlock being the predominant species. Douglas Fir is also present in significant numbers. Red Cedar and Red Alder are also present as minor components of the stand. The trees of the stand have an average DBH of 12.6 inches and an average height of 70 feet. The Douglas Fir are the largest with an average DBH of 13.3 inches and an average height of 78 feet.

FMU 22 will be commercial thinned starting in 2021-2026 with repeated entries every 15 years.

FMU 23

FMU 23 is 37 acres and the site index is 106. Currently FMU 23 is a 11 year old naturally regenerated stand. There are an average of 424 trees per acre with Douglas Fir being the predominant species. Red Alder is also present in significant numbers. Western Hemlock, Noble Fir, Bigleaf Maple, Red Cedar, and Cottonwood are also present as minor components of the stand. The trees of the stand have an average

DBH of 5.8 inches and an average height of 35 feet. The Cottonwood are the largest with an average DBH of 25.2 inches and an average height of 145 feet.

FMU23 will be pre-commercial thinned in 2026-2031 and then will be commercial thinned starting in 2041-2046 with repeated entries every 15 years.

FMU 24

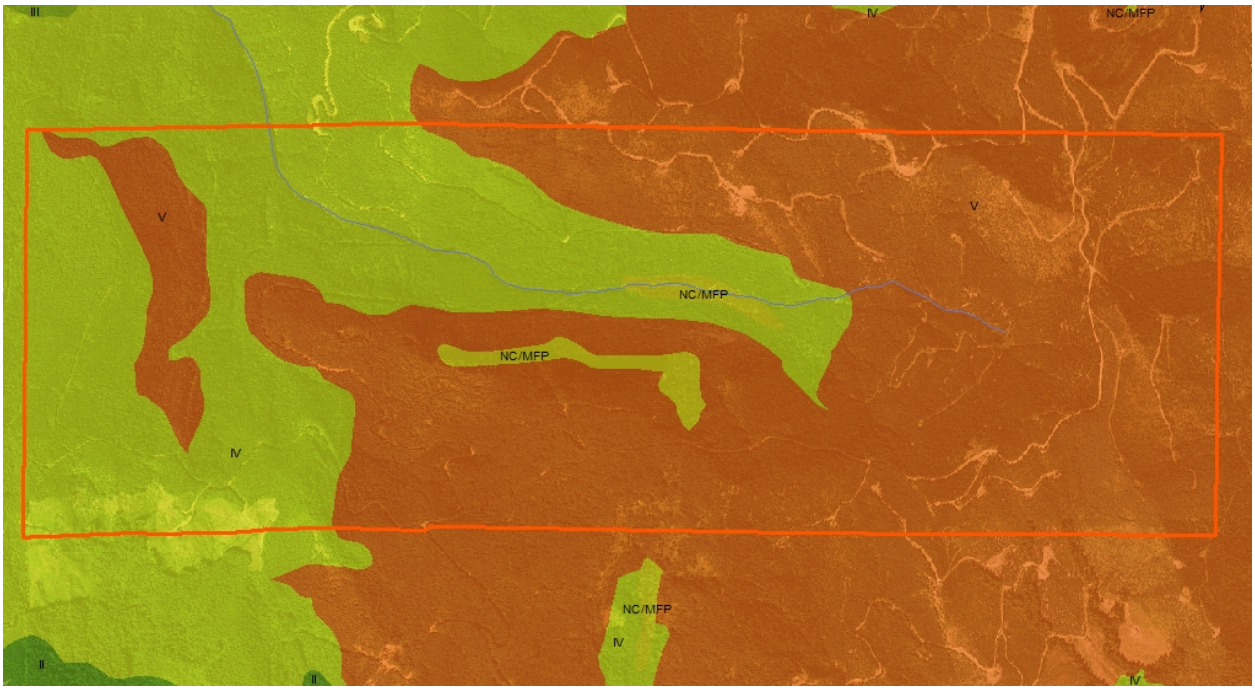
FMU 1 is 78 acres and the site index is 95. Currently FMU 24 is a 42 year old plantation. There are an average of 229 trees per acre with Silver Fir being the predominant species. Western Hemlock and Douglas fir are also present as minor components of the stand. The trees of the stand have an average DBH of 11.4 inches and an average height of 53 feet. The Western Hemlock are the largest with an average DBH of 12.8 inches and an average height of 57 feet.

FMU 24 will be commercial thinned starting in 2026-2031 with repeated entries every 15 years.

FMU 25

FMU 1 is 49 acres and the site index is 109. Currently FMU 25 is a 38 year old plantation. There are an average of 386 trees per acre with True Firs being the predominant species. Western Hemlock is also present in significant numbers. Red Alder, Douglas fir, and Grand fir are also present as minor components of the stand. The trees of the stand have an average DBH of 11.9 inches and an average height of 54 feet. The Western Hemlock are the largest with an average DBH of 13 inches and an average height of 57 feet.

FMU 25 will be commercial thinned starting in 2026-2031 with repeated entries every 15 years.



Site Class of the Upper Busy Wild Unit.

Forest Roads

Overview

Road System of the Upper Busy Wild Unit.

The Upper Busy Wild Unit has a combination of well-established network of forest access roads that remain suitable for vehicular use, and former haul roads that have been allowed to grow back over with vegetation. This road network provides near optimal access to all areas of the forest.

A full inventory of the road system will be made during the more in depth field review of the property.

Road Construction, Maintenance & Abandonment

A well designed, located, constructed, and maintained system of forest roads is essential to the management and protection of the reservation's forest resources. Riparian and wetland areas provide essential habitat for fish and wildlife and essential functions in the protection of water quality.

This section covers the location, design, construction, maintenance and abandonment of forest roads, stream crossings, and disposal sites used for forest road construction and is intended to assist landowners in proper road planning, construction and maintenance so as to protect reservation resources.

Road Location

a. Fit the road to the topography so that a minimum of alterations to the natural features will occur.
b. Minimize roads along or within narrow canyons.
c. Minimize the number of stream crossings and whenever practical cross streams at a right angle.
d. Minimize the total amount of road construction, while use existing roads whenever practical and avoid harvesting isolated patches of timber.
e. Wetlands and RMZ's: New road construction will be avoided within 200' of any stream or wetland.
f. Steep slopes: No new road construction will be allowed on slopes greater than 30%.

Forest Road Management Standards

1. Periodically maintain forest roads to ensure proper drainage and prevent erosion.
2. Prohibit new road construction on slopes greater than 30%.
3. Prohibit new road construction within 200' of any stream, wetland or old-growth tree.
4. Minimize new road construction in favor of more frequent landings or longer yarding distances.
5. Use WA DNR standards for sizing of drainage structures.
6. Avoid heavy equipment use on roads during wet season.
7. Imported road surfacing material must be from a certified weed free source.
8. All roads will be annually monitored for maintenance.
9. All road corridors will be monitored for invasive species annually (if not more often) and controlled within a month of identification (or a time period that is agreed upon by all). Where recent harvesting has occurred, those roads will be monitored first.

Road Design and Construction

a. Use the minimum design standard that produces a road sufficient to carry the anticipated traffic load with reasonable safety.
b. Subgrade width should average not more than 20' for single lane roads, exclusive of ditches, plus any additional width necessary for safe operations on curves and turnouts.
c. All roads should be outsloped or ditched on the uphill side and appropriate surface drainage shall be provided by the use of adequate cross drains, ditches, relief culverts, water bars or other such structures equally effective.
d. Surface drainage shall not discharge onto erodible soils, or over fill slopes unless adequate outfall protection is provided.
e. Install appropriate surface drainage concurrently with the construction of all forest roads to minimize erosion of the road bed, cut bank, and fill slope, and to reduce sedimentation.
f. Erosion control: Soil exposed by road construction that appears to be unstable or erodible, shall be seeded with ground cover or be treated by erosion control measures.
g. Waste and debris disposal shall not be placed in permanent roads or in wetland or riparian areas.
h. Construction shall be accomplished when moisture and soil conditions are not likely to result in excessive erosion and/or soil movement.
i. Log landings will be seeded, mulched, or covered with slash after use.

Water Crossing Structures

a. Culverts: All permanent culverts installed in forest roads shall be of a size that is adequate to carry the 50-year flood and no permanent culvert installed shall be smaller than 24 inches in diameter.
b. Alignment and slope of the culvert shall parallel the natural flow of the stream.
c. Construct the culvert below the natural stream bed at the inlet and outlet.
d. Terminate culverts on materials that will not erode and allow migration or spawning of anadromous fish.
e. Temporary culverts shall be promptly removed upon completion of use.

Maintenance

a. Active and inactive roads shall be maintained as necessary to minimize erosion and culverts and ditches shall be kept functional, and during and on completion of operations, road surfaces shall be crowned, outsloped, or water barred.
b. Abandoned roads shall be left in a condition suitable to control erosion and blocked so that four wheel vehicles cannot pass.
c. Brush control shall be performed manually or mechanically.

Wildlife Habitat

Overview

The purpose of wildlife enhancement is to conserve and/or increase the diversity and population of wildlife species native to forest habitats of this region. All wildlife species are products of their environment or habitat, and each species has specific and unique habitat requirement. Properly functioning habitat provides basic life requirements such as food and water, shelter, and protection from the weather and predators. Habitat diversity occurs naturally when natural events like fire, wind and ice storms, and insect and disease affect portions of the forest. These areas usually are re-vegetated in stages, beginning with shrubs, then seed trees, saplings and mature trees, and finally old-growth trees. With each successive stage, different combinations of wildlife species likewise appear, persist, and then decline. The diversity of wildlife species present depends on habitat diversity associated with these stages. Providing a diversity of habitats requires a diversity of areas in different stages of successional development. Timber harvesting can be used to mimic natural disturbances (e.g. windstorm) by opening dense forest stands and introducing a new progression of vegetation stages.

Wildlife Habitat Management Standards

1. Retention of existing snags and long-term recruitment snags of varying diameters and height, in particular larger diameter and taller snags.
2. Retention of downed logs of varying sizes and decay classes.
3. Retention of slash during timber harvests.
4. Retention of hardwoods and managing for a 25?/75? mix of hardwoods to conifers across the entire forest.
5. Utilizing small patch cuts (<6 acres) to establish early seral habitat.
6. Managing for variable densities.
7. Promoting mixed age and mixed species stands.
8. Retaining all trees greater than 36 inches dbh.
9. Setting aside no-harvest areas, in particular in proximity to streams and wetlands.

The uneven-aged silvicultural regime detailed in this FMP is expected to provide the broadest range of wildlife habitat opportunities possible for both terrestrial and aquatic species occupying the Nisqually Community Forest.

Landscape Design

Managing for ecologically diverse forests is a constant act of both ecological and economic tradeoffs, depending on revenue needs and wildlife habitat objectives. No singular forest should be expected to provide the entire breadth of habitat functions necessary to support all wildlife species in a particular region. Rather, the forest should be managed within the context of the larger landscape, and habitat features or functions that are missing or limited in the surrounding landscape can be managed for if there is a desire to improve populations of particular species (see wildlife habitat chart below). In this way, the forest, and the landscape in which is resides, provide a mosaic of habitat types that should provide optimal habitat conditions for all wildlife species. Wildlife corridors, in particular along riparian areas and other seasonal migratory routes, should be retained across the landscape, as well as forests of all ages, in particular old growth, which is significantly lacking in lowland and coastal environments.

Snags and downed logs

As a result of the past management history CONFIRM, the forest contain few large snags or downed logs. Snags and logs provide important structures for cavity-dependent bird and small mammal species, food sources for woodpeckers and other foragers, and a slow release nutrient resources for the forest in general. West of the Cascades in Oregon and Washington, 39 species of birds and 14 species of mammals depend on cavity trees for their survival. Terrestrial amphibians, small mammals, and birds also depend on large coarse woody debris for protection and foraging for insects, fungi, and seeds.

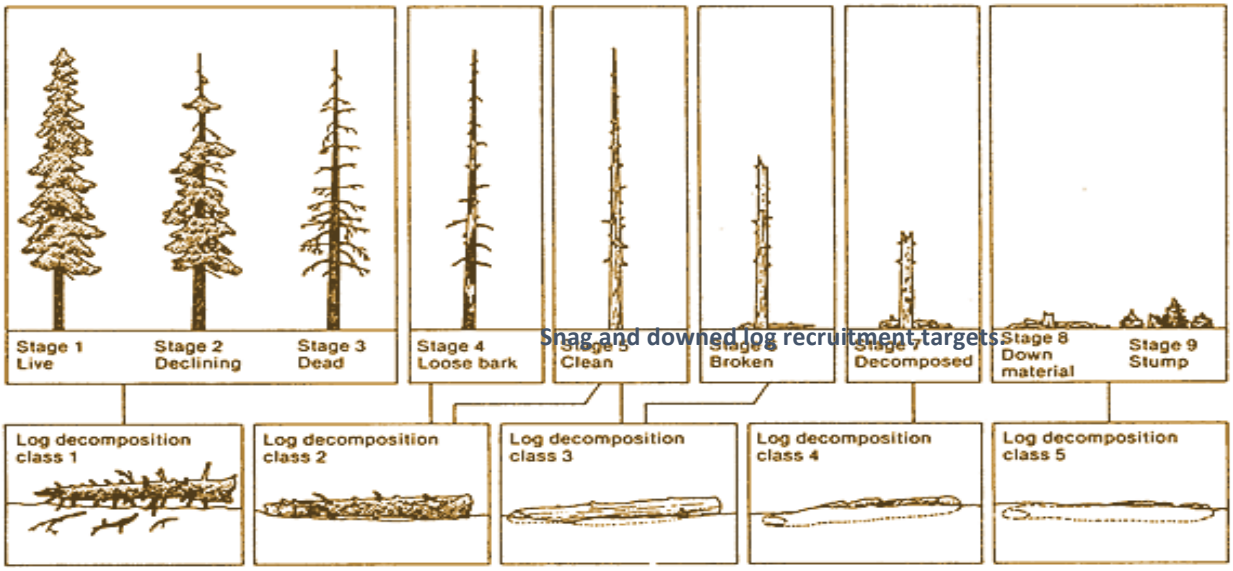
Snags fall into two primary decay class categories:

a. Hard snags, with the bark is still intact and with firm heart and sapwoods, and
b. Soft snags, which may have some bark remaining but with the wood beginning to soften.

Downed logs fall into five primary categories based on their decay class:

a. Class 1, bark is still intact and heart and sapwood is still firm
b. Class 2, log is in contact with ground; bark is beginning to deteriorate and inner wood is soft.
c. Class 3, log is in contact with ground; bark has completely fallen off and log is beginning to become incorporated into the forest floor
d. Class 4, log is partially buried and wood is very soft
e. Class 5, log is barely distinguishable from surrounding forest floor

Snag and downed log classifications



Snag and downed log recruitment targets

A short and long-term snag and downed log recruitment program will be initiated. Short-term snag/log recruitment will be achieved by protecting existing snags and logs during harvest activities at levels as close to the listed targets as possible. Long-term snag/log recruitment will be achieved by retaining defective trees at various stages of deterioration during harvesting activities. Root rot and windthrow will naturally recruit snags and logs, and non-merchantable log sections will be redistributed throughout the forest during harvest activities.

Riparian Wildlife Corridors

Riparian forests will be managed to provide habitat connectivity between lowland and upland ecosystems. Management practices will focus on developing complex late seral forest structure within a minimum of 200 feet from either side of the bank-full width of any seasonal or perennial stream, or to the break-in-slope where slope gradient becomes less than 50 percent. Harvesting will be limited to individual tree selection.

Snag and downed log recruitment targets

Snag	**Minimum Size**	**#/acre**
Hard	17’ tall x 15” dbh	2-5
Soft	17’ tall x 15” dbh	2-5
Downed woody debris	**Minimum size**	**#/acre**
Class 1	16’ x 20” dia.	1-3
Class 2	16’ x 20” dia.	1-3
Class 3	16’ x 20” dia.	1-3
Class 4	16’ x 20” dia.	1-3
Class 5	16’ x 20” dia.	1-3

Recreation

Overview

Current recreation on the property consists almost entirely of use of the forest road system during the winter by the Mt Tahoma Trails Association for cross country skiing and snowshoeing.

Management Recommendations

Management recommendations for recreation await the final development of the Nisqually Community Forest recreation policy and plan.